INTEGRATED SYSTEM FOR AGRICULTURAL DRAINAGE MANAGEMENT ON IRRIGATED FARMLAND

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Report prepared for the U.S. Bureau of Reclamation
June 1999

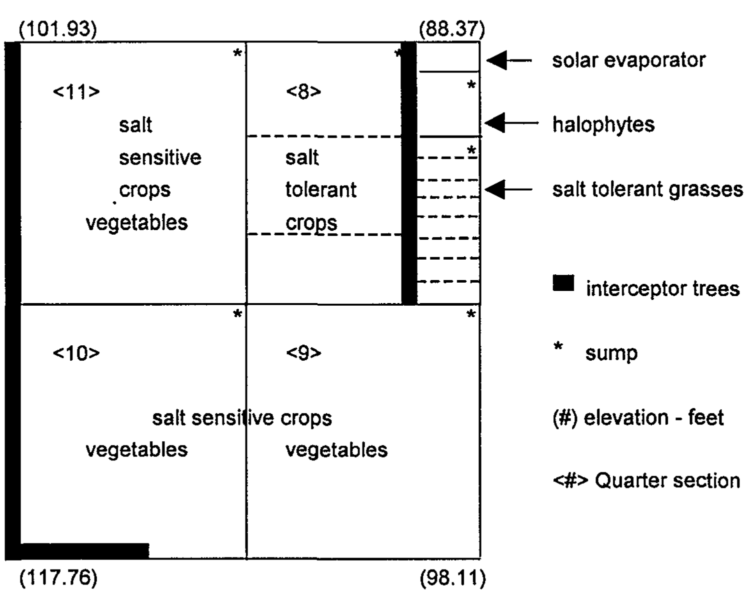
Executive summary

The report presents the results of the drainage project at the Red Rock Ranch, Five Points. This project demonstrates the possibility of managing drainage water, salt and selenium as resources rather than wastes. The grower sequentially reuses drainage water to produce crops of differentiated salinity tolerance. A solar evaporator receives the final volume of drainage water; this water evaporates and salt crystallizes. Plants uptake selenium which also volatilizes; the remaining selenium becomes a component of harvested salt. There is no disposal of salts and selenium into rivers or evaporation ponds. Drainage water, salts and selenium do not leave the farm. These are the principles of an Integrated on-Farm Drainage Management (IFDM) system.

John Diener and other growers in the Westside Resource Conservation District played a leading role in the development of this technology. A professional staff of several government agencies, universities, and consultants provided the required assistance to growers. Government agencies included the USDA-Natural Resources Conservation Service, California Department of Water Resources, California Department of Food and Agriculture, Regional Water Quality Control Board, and U.S. Fish and Wildlife Service. Researchers from the University of California, Davis, and California State University Fresno also participated. The grower, John Diener, and the U.S. Bureau of Reclamation funded the project.

The following chart illustrates the project design:

Red Rock Ranch
Intergrated On-Farm Drainage Management



There are four salinity areas (zones) on the farm. Vegetable crops, grown in the non-saline zone representing 73.4 percent of the farm area, receive irrigation water from a canal or a well. Alfalfa, cotton and other salt-tolerant commercial crops, grown on 20.3 percent of the farm in the low-saline zone, receive drainage water from vegetables. Salt-tolerant grasses and trees grown in the moderate-saline zone on 2.0 percent of the farmland use drainage water from salt-tolerant crops. At the last step of the sequential reuse, the grower applies saline water from salt tolerant grasses/trees to irrigate halophytes grown in the high-saline zone representing about 0.8 percent of the farmland. This sequential water reuse process productively uses over 90 percent of the drainage water. The remaining drainage water goes into a solar evaporator for water to evaporate and salt to crystallize. The solar evaporator represents 0.3 percent of the farm area.

This 620-acre farm includes several drainage systems. There are three 157-acre independent drainage systems for vegetable crops. Independent drainage systems also operate for salt-tolerant crops/trees (130 acres) and salt-tolerant grasses (13 acres). A shared drainage system exists for the halophytes (5 acres) and the solar evaporator (2 acres).

The water distribution system provides for irrigation of the vegetables with the Westlands Water District canal water or on-farm well water. Salt-tolerant crops/trees receive a blend of drainage water and tail water (from vegetables), and of canal/well water. Salt-tolerant grasses and halophytes are only using sequentially reused drainage water. Programmable electronic timers control water distribution to salt-tolerant grasses, halophytes and the solar evaporator.

The installation of the drainage system started in 1995. The following data indicate the progress of soil reclamation achieved:

	Soil samples -- Ece (dS/m)			
Depth	1995	1996	1997	1998
0-1 feet	11.3	2.3	1.5	0.8
1-2 feet	8.8	7.1	5.7	4.4
2-3 feet	8.6	8.9	7.6	4.8

	Soil samples -- Boron (mg/L)			
Depth	1995	1996	1997	1998
0-1 feet	14.3	3.1	2.5	1.1
1-2 feet	13.3	6.8	8.3	1.6
2-3 feet	8.5	10.5	10.6	2

Alfalfa, grown for two and one-half years, helped to improve soil conditions. The fast rate of salt and boron leaching provided the opportunity to plant the first vegetable crop in the fall season of 1998.

Monitored data also indicate these reductions of selenium concentrations:

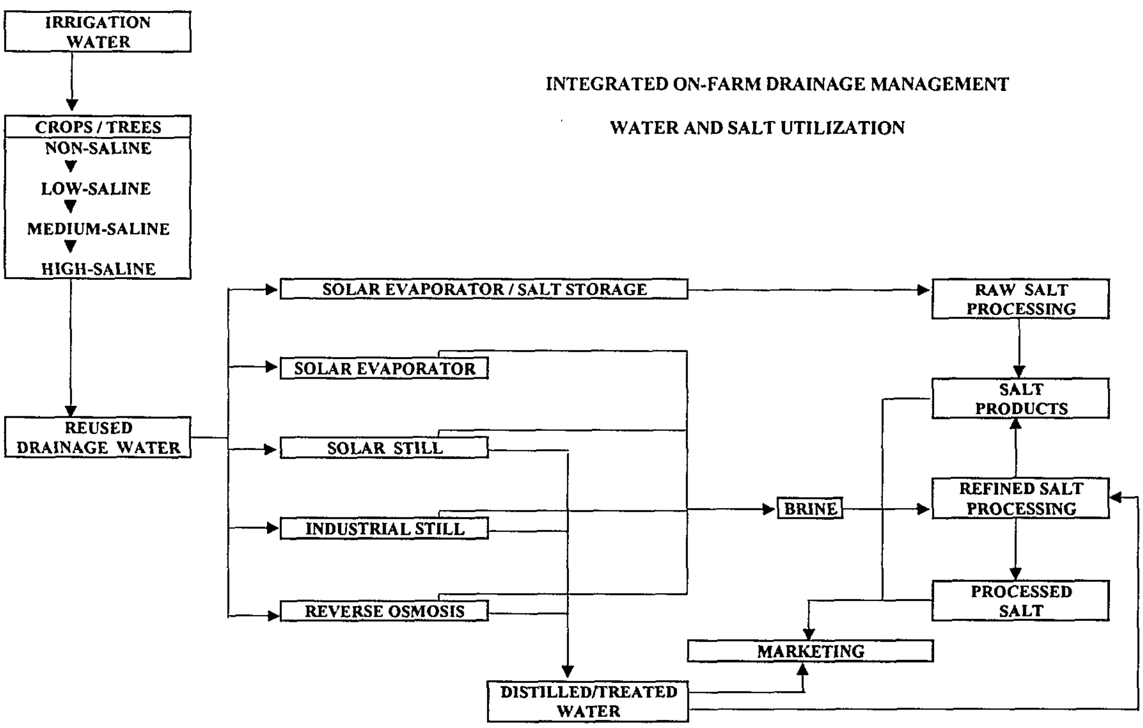
	Quarter Sections	
Date	SW	SE
8/95	308	2225
8/96	176	769
9/98	160	610

Sequential reuse of drainage water increases the overall efficiency of water use. The total use of irrigation water is about 1601 acre-feet. The farm input-water is 1215 acre-feet (76 percent). The sequentially reused drainage and tail waters represent 386 acre-feet (24 percent). The solar evaporator receives only about 12 acre-feet (3 percent) of sequentially reused drainage water. The average use of the canal or well water is about 1.96 acre-feet per acre on this farm. While conventional farming would require about 1550 acre-feet of canal water, an IFDM system requires 1215 acre-feet of irrigation water, at a water savings of about 22 percent. In addition to significant water conservation, the IFDM system also prevents on-farm drainage water from contributing to severe regional problems of poor ground water quality and high water tables.

The total project costs were $376,000, which averages $606 per acre. This investment includes the drainage system, the water distribution system, the solar evaporator, and the establishment of salt-tolerant grasses, trees, and halophytes. The land value was about $480,000 ($750 per acre) before the IFDM system was implemented. The present value of reclaimed land is about $1,540,000, with the average value of $2,406 per acre. The land value increase is about $1,060,000 per farm or $1,656 per acre. The ratio of the increased land value to the total project costs is 2.8: 1.

Higher crop yields and the production of high-value vegetable crops, grown on the non-saline portion (75 percent) of the farm, caused the increase of land value. Wheat yield increased from 1 ton per acre (before reclamation) to the present 4 tons per acre. While previous net returns from growing cotton, alfalfa, and grains on saline land were about $175 per acre, the net returns from vegetable crops average about $550 per acre.

Basically, the IFDM is a salt management system. The saline water leached from the vegetable area moves through a sequential reuse of drainage water all the way to halophytes and the solar evaporator to harvest the salt. Salt utilization and marketing are the next stages of the project. The following chart illustrates the concept of salt management:



The demonstration of the IFDM at Red Rock Ranch indicates the technical feasibility of the project. The system offers significant economic benefits. Managing drainage water, salt, and selenium as resources on a farm protects the quality of surface and ground water. Therefore, the system also offers significant environmental benefits.

D-042809

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